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ABSTRACT

This issue contains articles on experiences gained in the construction of terminal performance objectives for introductory biology courses, the impact of audiotutorial instruction on faculty load and departmental operating levels, an experiment designed to improve the teaching of biology in large enrollment introductory courses, a minicourse on making BIOTECH modules, and a report of the 1972-1973 AIBS Manpower Survey. (PEB)

AMERICAN INSTITUTE OF BIOLOGICAL SCIENCES EDUCATION DIVISION

# AIBS EDUCATION REVIEW

VOL. 2
NO.4
OCTOBER 1973



## AIBS Education Review to be Available to Members Only

Dear Readers:

For two years the *AIBS Education Review* has been sent to all AIBS members and over 13,000 non-members who expressed interest in biological education. This service has been made posssible in part from a grant for educational activities which will not be available after 1973. Therefore, it is necessary to limit our circulation to AIBS members effective January 1974. The quality of this publication has increased with each issue and it is a valuable service AIBS provides its members. It is copyrighted, carries referenced articles, and has a review board.

While the *Review* represents a significant part of AIBS efforts on behalf of biological educators, there are other benefits of membership. *BioScience*, the official AIBS journal, is published monthly and contains articles on a wide range of topics of interest to biology teachers. Members are also entitled to use the AIBS Placement Service.

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Sincerely,

John R. Olive

John R. Olive
Director

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# EXPERIENCES IN THE CONSTRUCTION OF TERMINAL PERFORMANCE OBJECTIVES

**Eldon D. Enger, J. Richard Kormelink, Rodney J. Smith**
Delta College
University Center, Michigan 48710

For a number of years we have been in the process of reevaluating the course content and methods employed in teaching our introductory biology course; however, we lacked specific agreed upon objectives. Much of the disagreement was not in what should be covered but more in the individual faculty interpretation of the depth of coverage and the methods to be used in presenting the information. Since the enrollment in our typical introductory biology course consists of students with diverse backgrounds and a multiplicity of goals, we felt that we could function more effectively if we had specific objectives that had been developed collectively.

What follows is a technique that was valuable to us in determining course content and in clarifying what were the essential, fundamental concepts. The resulting *terminal performance objectives* specified how we expected the student to demonstrate his mastery of these concepts.

### Why We Did It

At community colleges we profess to be student centered but in fact we probably have not been as attuned to fostering student success as we should be. The establishment of student oriented *terminal performance objectives* is of paramount importance in facilitating success in our course. If these objectives really work, the student should know what subject matter will be covered and how he will be required to demonstrate his understanding of the material. This eliminates the guessing games about what is important and what is not. We feel that it is inappropriate to reward students who are good at deciphering how they will be evaluated, and penalizing those students who aren't so gifted.

It was deemed advisable to establish uniform course content while maintaining the individuality of approach. A guide to course content would be valuable to all instructors, but would be of particular value to those instructors teaching the course for the first time. Uniformity of course content will also facilitate the subsequent enrollment of students in advanced courses.

An important external pressure being applied to state supported institutions in the State of Michigan is the requirement of greater accountability to the state legislature for the funds dispersed to these institutions. The development of measurable *terminal performance objectives* provides the legislature and the public with an unambiguous statement of what the course accomplishes.

### How We Did It

In our particular situation the procedure followed was based on a team approach in which each of the members of the team was recognized as being competent in the subject and all deliberations were based on mutual respect and confidence.

Over a period of about a year a number of individuals attempted to write "behavioral objectives" for the introductory biology course. These were of limited success. A number of people read Mager's book (1962) dealing with the topic and further attempts were made to write "behavioral objectives." A series of workshops were held with a consultant. The consultant was very helpful in providing us with insight into the value of brainstorming and the technique of deferred judgment. He also clarified the different stages in the development of *terminal performance objectives*.

Following this initial period in which we gained an insight into the construction of *terminal performance objectives* we began in earnest. We started by holding a brainstorming session to establish the broad general coverage for the course. In this type of brainstorming session each individual suggested any topic that he felt appropriate for the course. A time limit was imposed and observed. One of the members of the team served as recorder for the topics suggested. All topics were accepted and judgment of their value was deferred until a later time. Some of the broad topics suggested were: respiration, evolution, survey of the plant and animal kingdoms, embryology, genetics, photosynthesis, microbiology, homeostasis, and cells. After much discussion, persuasion, coercion, and argument, five major areas were established.

For each of these five major areas of the course we wrote a broadly based goal statement. This statement was a *general statement* of what we expected the student to learn in this section of the course. One of the major topic areas is ecology. The ecology goal statement reads as follows:

> The student shall be able to describe and recognize (a) intra-species and inter-species interactions in an ecosystem; (b) biotic and abiotic interactions in an ecosystem; and (c) how these interrelationships are changed through time.

We then selected each of the five major areas in turn and held a brainstorming session in which we listed the information that should be covered in each major topic area within the confines of our goal statements. An extensive list was developed without judging the value of any particular idea. These ideas were then placed in categories. At this point some of the suggested ideas were judged to be inappropriate and were eliminated by mutual consent.

While we categorized ideas we solidified our thinking into *specific* terminal performance objectives. There was a good deal of give and take and discussion about why something should be included and what was important for the student to understand as well as why he should understand it. Particular attention was given to how we wanted the student to demonstrate his understanding of the subject matter. The construction of the terminal performance objectives involved critical examination of word usage and the meaning of the statement, so that the statement was an unambiguous codification of our thinking. The terminal performance objectives which were constructed for the ecology section follow:

### Terminal Performance Objectives

A. Ecosystem - the student shall recognize that the ecosystem is a stable collection of interacting abiotic factors and living organisms involved in the capture, utilization, and flow of energy.

   1. There is a positive correlation between the complexity of interaction within an ecosystem and the stability of the ecosystem.

2. The student shall recognize that materials are recycled in an ecosystem.

3. The student shall recognize that energy flow—following the laws of thermodynamics—proceeds through the trophic level.

4. The student shall recognize that the living part of an ecosystem is primarily determined by abiotic conditions.

5. The student shall recognize that ecosystems evolve through a series of predictable changes from a pioneer to a climax community dependent upon the specific abiotic factors and the biotic history of the area.

6. The student shall recognize that man as an organism, with a complex social order and high level of technology, has the capacity to cause changes in both the biotic and abiotic aspects of the ecosystem. These changes brought about by man can be both accelerated natural changes and changes unique to his influences.

B. The student shall recognize that a community is composed of a variety of populations which interact both positively and negatively with each other. The student shall recognize that the ecological niche is the composite of all the roles which an organism plays in his environment. The environment is considered to be the sum total of all the experiences of an organism, including the abiotic and biotic aspects of the habitat of the organism.

C. The student shall recognize that a population is composed of a designated group of individuals of one species possessing characteristics above and beyond the characteristics of its members.

1. The student shall recognize that the population is the evolutionary unit.

2. The student shall recognize that the carrying capacity is the number of individuals of a species which can be supported within the confines of a designated area. The carrying capacity is determined by the interactions within the ecosystem.

### Was It Worth It?

As in any endeavor of this type there are both positive and negative aspects. One of the major problems is overcoming the inertia and complacency that is a common feature of most departments. A start can be made when a nucleus of interested faculty can be committed to spending the time required. A considerable amount of time must be committed to learn the techniques and apply these techniques. It is unrealistic to attempt to get *all* faculty involved in a project of this type. In our case we were three of seven faculty involved in teaching the introductory biology course. All of the seven were interested and spent some time on the project but were unable to commit the time throughout the entire project which extended over two semesters.

In writing terminal performance objectives, we have accomplished the following goals:

1. Clarification of course content expedites justification of dollar commitments for personnel, equipment, teaching supplies, services, and types of facilities required to teach the course.

2. These goal statements and terminal performance objectives go beyond typical catalog descriptions and allow for more rational selection of courses for curricula. It should be of particular value to the counseling staff.

3. Instructors teaching the course for the first time have a clear understanding of what should be covered without having teaching techniques and methods dictated to him.

4. With a clear statement of course content, the selection of texts, lab manuals, films, other teaching materials, and the construction of evaluation devices can be made to meet stated objectives.

5. A logical extension of this procedure is the construction of specific behavioral objectives by each instructor which tell the student exactly what is required and how he will be evaluated.

In addition to these values we gained a greater respect for one another and an *esprit de corps* among the members of the department, which itself is well worth the effort expended.

### Reference

Mager, R. F. 1962. Preparing Instructional Objectives. Fearon Publishers, Palo Alto, Calif.

### Errata

We regret the following errors which appeared in recent issues of the *AIBS Education Review*. In the article "The phase achievement system I. An instructional management system for large enrollment lecture sections," *AIBS Education Review*, 2(2):24-27 1973, one of the authors was erroneously listed as F.G. Covert instead of G.F. Covert. On page 27, the reference to "Covert et al. 1973" should have been completed to read: "Covert et al., The phase achievement system II. A computer system for large enrollment lecture sections, unpublished." This article has subsequently been published in the *AIBS Education Review*, 2(3):40-42 1973. The authors of this article should have been listed as G.F. Covert, W.D. Dolphin, and R.G. Franke instead of W.D. Dolphin, R.G. Franke, F.G. Covert, and C.D. Jorgensen.

## PROJECT BIOTECH NOTES

**Richard A. Dodge**
AIBS Staff

Project BIOTECH has recently been refunded and authorized by the National Science Foundation to continue developing biological single task skill modules. Sixty additional modules will be selected from skill topic areas such as allied health, environmental sciences, field and museum techniques, food technology, and animal handling. Writers are needed to help develop these modules. For information concerning skill topics being sought, proper format, and stipends offered, please write: Project BIOTECH, American Institute of Biological Sciences, 3900 Wisconsin Avenue, N.W., Washington, D.C. 20016.

# THE IMPACT OF AUDIO-TUTORIAL INSTRUCTION ON FACULTY LOAD AND DEPARTMENTAL OPERATING LEVELS

**Thomas C. Hahn**
Life Science Department
Southwestern College
Chula Vista, California 92010

The educational revolution is upon us, with such educational technologies as the instructional systems approach (audio-tutorial and audio-visual-tutorial), computer-assisted instruction (CAI), educational television and videotape, and instant response systems. Often, such technologies are touted by the hardware-software manufacturers as the "latest thing" in instructional innovation, and "guaranteed" to improve instruction. Coupled with the technology of the educational revolution are several distinct philosophical considerations: (1) the general feeling that instruction must be made relevant to the contemporary scene, (2) that instruction must be "individualized" with a goal of educating all students to their fullest potential, (3) that no matter what instructional modality is employed, student-teacher contact must be maintained, (4) that instructional costs must be lowered and the efficiency of instructional operations be maximized.

These philosophical viewpoints are essentially derived from two "opposing camps"—the student body on one hand, insisting on relevancy, individualization, and maximum teacher contact, and the public and/or taxpayer on the other, vis-à-vis the trustees and administrators, demanding efficiency and a lowering of instructional costs. Positioned squarely between these two groups are the teaching faculties attempting to carry on with the educational process and simultaneously fulfill the expectations of both sides. To meet these challenges, educators have been encouraged by students, administrators, boards of trustees, the public, and the hardware-software manufacturers, to experiment with a wide variety of multi-media and individualized approaches to the learning environment.

A great deal of the "success" of such programs rests with how participating faculty and departments are treated when individual work schedules and group operational levels are negotiated with, or mandated by, administrative personnel. The majority of faculty participating in the development or application of an innovative instructional technique express the desire for preferential treatment in the creation of their individual and group work load schedules. This stems from an obvious increase in faculty time commitments when conventional curricula are restructured as multi-media and individualized instructional modalities. According to Hinton (1970), "an enormous amount of work is required for faculty who engage in the A-T method, and one would be hard pressed to find an audio-tutorial instructor who seriously considered his "load." Administrators often make minor concessions in loading policy as incentives to stimulate the development of new programs. However, as programs are developed, made operational, and become a part of the established curricula, modifications in both the program structure and in staffing needs occur.

Administrative evaluation of such programs typically involves a cost benefit analysis, i.e., "Is the program paying for itself" or, "Are we doing a better job for less money?" Often, there are no concrete answers to these questions. The lack of substantive evaluation data may result in administrative attempts to more effectively amortize the initial "hardware" costs and also cut staffing expenses. In an attempt to create a "financial rationale" for the program, adjustment of original "temporary" concessions in the loading policy and other staffing modifications may create a bitter atmosphere among the program faculty. They perceive their workload increased by the necessity for continual program modification in view of faculty and student evaluation. Both sides, administrators and faculty, often fail to see educational innovation as a continuing process, based on feedback data from evaluation instruments.

Often a new technology is applied without an adequate assessment of its impact on issues such as the faculty workload and departmental operational level, in conjunction with faculty involvement in continuing evaluation and program modification. In the initial planning stages, such parameters are "lost" as peripheral issues when compared to other weightier problems of instructional innovation and change.

This paper will examine the basic assumptions, philosophy, and procedures involved in establishing faculty loading policy and departmental operating levels at Southwestern College. The application of these policies to a specific individualized instructional modality (i.e. Audio-Tutorial Biology [Biology I]) will be reviewed. The objective of this analysis and review, and the primary purpose of this paper, is to derive a generalized loading model which will allow prospective innovators to predict the effect that adoption of certain instructional technologies will have on the workloads of participating faculty and on their departments' operating level.

### The Audio-Tutorial Biology Program

The audio-tutorial program in biology at Southwestern College began operations in the fall semester 1968. Over its four year history the program has maintained the essential features of the Postlethwait Model (1967), with modifications in response to local requirements. A detailed history of the program is available in the current literature (Hahn 1971). The program currently enrolls 320 students each semester, handled by a 36 station facility. The course structure includes four major components: the general assembly session, the small group session, the audio-tutorial or independent learning session, and the quiz session.

In addition to these formal components/activities, the audio-tutorial program also includes the following informal activities:

**Group tutoring:** Interested students are encouraged to get together informally in the evenings for unstructured discussion sessions, with an instructor "on call" for consultation.

**Group review sessions:** Pre-examination group review sessions are held during the late afternoons and evenings for the benefit of all students who wish to participate.

**Bilingual study materials:** A complete library of Spanish translations of the major life science textbooks is available for student loan. In addition, special bilingual (Spanish) tapes and a Spanish translation of the biological vocabulary are currently under development.

## The Concept of Operating Level

Operating level (OL) is a term applied to "index data" which give "management" the opportunity to evaluate the relative efficiency of an instructional program. Typically, a department chairman or area dean will compute a departmental operational level by dividing the number of faculty (full-time, part-time, and paraprofessionals) into the total number of weekly student contact hours for the department. For example, the life science department at Southwestern College was rated in the fall of 1972 as having 5.56 Full-time Instructor Equivalents (FTIE). This included five full-time instructors, two part-time instructors, and five paraprofessionals (tutors). Full-time equivalencies for part-time and paraprofessional staff are computed on the basis of cost per hour compared to a standardized mean annual salary of $14,500.00. Weekly Student Contact Hours (WSCH) are computed course by course. For example, Biology I includes one hour of general assembly, one hour of small group discussion, and four hours of audio-tutorial instruction per week. Thus, each enrolled student generates six contact hours per week in the course.

Operating level is generally considered to be related to teaching efficiency and cost effectiveness. However, there are no generally agreed upon criteria set for what constitutes either "efficient" or "low cost" instruction as one moves from curriculum to curriculum, department to department, or from campus to campus. Historically, at Southwestern College, operating level(s) have been used as suggested guidelines. The set level for campus-wide attainment is 500, although individual departments fall far below and far exceed this mean level. There are no statewide (e.g., as in California) rationales for any specific operational level and many schools exclude mandated, small-enrollment courses from their calculations. Thus, a statewide guide for comparative purposes is lacking.

Fundamentally, departments at Southwestern College are allowed the option of managing their own curricula within the framework of a "suggested" operating level, based on historical record. Therefore, a department may opt to teach several low-enrollment courses or experiment with a new instructional technique as long as they strive to maintain an annual OL commensurate with the established guideline. Each department's OL is reviewed annually by department chairmen and area deans. New OL's may be set based on changes in enrollment patterns, instructional methods, staff needs, etc. Since innovative instructional methods can have such a significant effect on staffing, faculty loads, and consequently departmental operating levels, a review of the impact that the A-T instructional mode has had on these areas is in order.

A sample analysis of faculty load and operating level is given below.

The following abbreviations are used:

- FTIE = Full-Time Instructional Equivalents
- LHE = Lecture Hour Equivalents
- WSCH = Weekly Student Contact Hours
- OL = Operating Level

**Conventional Instruction (Fall 1966)**

4 sections x 3 hours = 12 LHE
311 students ÷ 32 = 10 labs @ 3 hours = 30 hours
30 lab hours x 2/3 credit per hour = 20 LHE
32 LHE ÷ 15 (full-time teaching) = 2.13 FTIE

$$OL = \frac{311 \times 6}{2.13\ \text{FTIE}} = \frac{1866\ \text{WSCH}}{2.13\ \text{FTIE}} = 876.056$$

**Audio-Tutorial Instruction (Fall 1968)**

1 General Assembly Session = 3 LHE
20 Small Group Sessions = 20 LHE
40 hours A-T lab x 2/3 = 27 LHE

TOTAL: 50 LHE

50 LHE ÷ 15 = 3.3 FTIE

$$OL = \frac{295 \times 6}{3.3\ \text{FTIE}} = \frac{1770\ \text{WSCH}}{3.3\ \text{FTIE}} = 536.363$$

Data for all terms from 1966 to 1972 are given in Fig. 1.

An analysis of the data presented in Fig. 1 indicates that implementation of the audio-tutorial program initially resulted in a severe reduction in the operating level of the course (and the department). The conventional lecture-laboratory mode of instruction used prior to implementation of the A-T curriculum generated a $\bar{x}$ OL of 898.2. During a five semester period after the A-T program was initiated, the OL for the course averaged 559.95, as a result of staffing the program entirely with full-time personnel. It was not until 1971 that paraprofessional tutor assistance was employed in the A-T learning center. The progressive shift in staffing of the center from full-time faculty to tutors culminated in the spring of 1972 where the OL reached its all time peak (1137.423).

At the same time that the department was increasing its use of tutors in the A-T center, full-time staff were increasing their commitment to specialty courses. For example, in fall 1971, additional sections were offered in Botany 1 (General Botany) and Zoology 8 (Human Anatomy); while in spring 1972, additional sections of Biology 7 (Microbiology), Zoology 22 (Human Physiology), and Zoology 20B (Anatomy-Physiology) were offered. This increased commitment to specialty courses also substantially increased the weekly student contact hours (WSCH) in each course, i.e., Botany 1: 32 students x 6 contact hours (CH)/wk. = 192 WSCH; Zoology 8: 32 students x 8 CH/wk. = 256 WSCH; Biology 7: 32 students x 8 CH/wk. = 256 WSCH; Zoology 20B: 24 students x 4 CH/wk. = 106 WSCH; and Zoology 22: 24 students x 6 CH/wk. = 144 WSCH.

The increased tutor use in Biology 1 and enrollment gains in speciality courses raised the overall departmental OL in a fashion which parallels the gains in the OL for the Biology 1 course (See Table 1).

**Table 1.**
**A Comparison of Biology I and Overall Departmental Operating Levels (1970-1972)**

| Semester | Biology I OL | Departmental OL |
|---|---|---|
| Fall 1970 | 559.766 | 595.23 |
| Spring 1971 | 657.831 | 588.67 |
| Fall 1971 | 787.5 | 719 |
| Spring 1972 | 1137.423 | 707 |
| Fall 1972 | 872.727 | 611 |

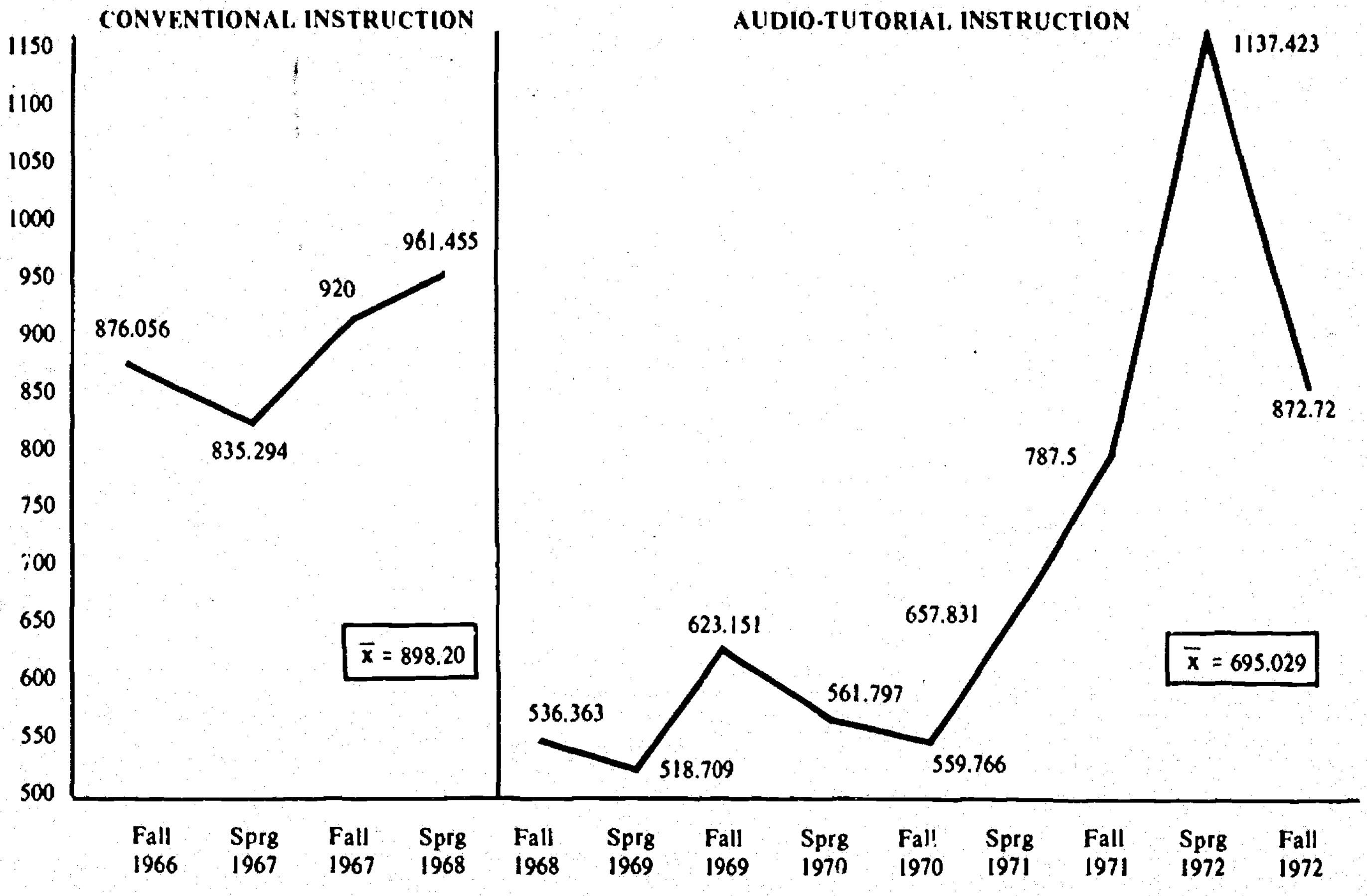



**Fig. 1. Life Science Department: Analysis of Faculty Load/Departmental Operating Level as Related to Biology I. Comparison of Conventional (Lecture-Laboratory) and Audio-Tutorial Instruction Modes.**

Essentially, the department had opted to substantially increase its OL ($\bar{x}$ OL 863.87 for the period spring 1971-fall 1972) by reducing the level of faculty-student contact in the A-T learning center. Thus, the overall efficiency of departmental operations gained dramatically as a result. Although these are laudable achievements, there are certain negative features coupled to them. Use of tutors to operate the A-T center may release instructors to other duties, but also reduces student contact time with the full-time staff. It also tends to foster an "out-of-sight-out-of-mind" attitude on the part of the faculty, who become increasingly involved with their specialty courses. This trend was reviewed by the departmental staff in spring 1972 with the central issue being a consideration of efficiency weighed against the effect of total faculty withdrawal from the A-T center in relation to the educational values of the program. A faculty concensus plan to modify tutor use and increase staff-student contact in the A-T center was implemented in the fall semester 1972. This involved adjusting tutor loads in the center and assigning additional part-time staff to teach some of the small group sessions (SGS). Full-time staff relieved from selected SGS assignments were then reassigned into the A-T center on a three for two lab-lecture hour equivalent ratio. Table 1 reflects the effect that this plan has had on both course and departmental operating levels—both decreased significantly from previously established "highs". Thus, although departmental "paper efficiency" has decreased, staff attitudes about the program have improved markedly.

### Generalized Loading Model

Production of a generalized model to predict the impact of various instructional technologies on the loads of participating faculties and on their departmental operating level is an exceedingly difficult task, especially when one is attempting to generalize from a data base consisting of one case study. However, although a complete "model" cannot be realized, several significant component parameters of such a model can be identified.

Three such parameters have been revealed in this study, namely: (1) Faculty load does *not* decrease with implementation of audio-tutorial methods, but substantially increases in view of the continuing evaluation and modification of the programs. Teaching load *only* decreases when paraprofessionals (tutors, lab assistants, teachers' aides, etc.) personnel are utilized in the "individualized" and "programmed" portion of the instructional process *in lieu* of full-time (and more expensive) faculty. (2) Restructuring conventional instructional programs into individualized, programmed modes involving both hardware and software can result in substantial reductions in equipment and facilities use costs. However, this must be tempered with the realization that programmed instructional units rely heavily on mass "demonstration" rather than individual "experimental" approaches. Although financially beneficial, the educational value of such practices may be questioned. (3) Instructional technologies in the form of individually programmed systems appear to facilitate the "handling" and "processing" of large numbers of students with essentially no substantial increases in faculty or facility costs. The problem of increasing enrollments disappears when one works with audio-tutorials. A slight increase in learning center hours, supplies, and paraprofessional hours are all that is required to accommodate a relatively large enrollment gain. Thus, operation costs progressively shrink as enrollment and operating levels gain. However, once again the educational value of handling large numbers of students in an "efficient", but in a mechanical and impersonal manner, must be considered. The "dehumanizing" effects of the instructional systems approach to teaching has been discussed by Monroe (1972) in his consideration of the future prospects of such instructional modes. He states:

> ...at the present, there is little evidence that students would welcome innovation which would decrease personal contacts with a live personality. If the systems approach retains the close relationship between teacher and student, and its advocates claim an even closer one-to-one ratio between student and teacher, then students will accept the mechanization process. However, any new system of teaching which places a greater distance between teacher and learner is destined to be rejected. The impersonality of large lecture sections and the tendency for a minority of the teachers to reject students as human beings who need personal attention are primary incentives for students to be unhappy with their college experience. The community college student who does not come to college with a high degree of built-in motivation requires a live, creative, and stimulating teacher as a prime mover. Even though it has been demonstrated that students can learn independently without a teacher through the use of televised classes, programmed learning manuals, or correspondence courses and that students would welcome the opportunity to progress at their own rate in their studies, in reality, most community college students continue to prefer to do their learning in the company of other students and even in an atmosphere of competition with their classmates. Any form of instruction in which the content is formalized or "canned," and the learning process is routinized into a formal step-by-step procedure, although psychologically sound as interpreted by the behaviorist school, is enjoyed by students no more than they enjoy lecturers who repeat the same dull lectures year after year.

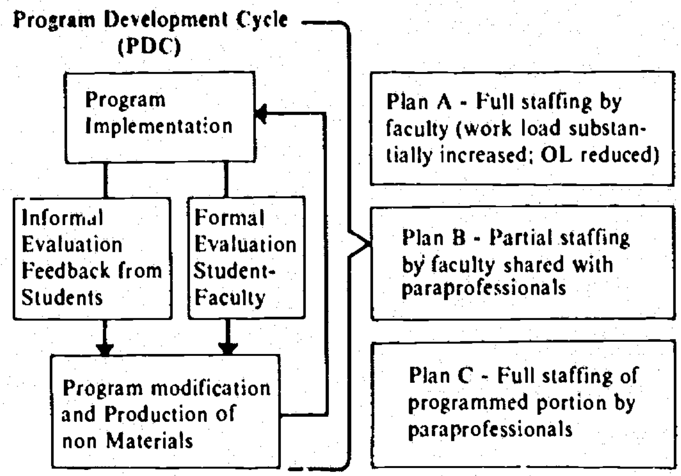
In summary, faculties who intend on implementing audio-tutorials (and possibly other instructional technologies) in their departmental curricula, should expect some major adjustments in individual loading and in departmental operations. A schematic flow chart illustrating the possible effects of instructional technologies on faculty load and department OL including alternative plans are given in Fig. 2.

## SHORT COURSES TO BE OFFERED AT 1974 ANNUAL MEETING

Since the Minicourse on Module Making, which was offered at the 1973 meeting, was an extremely successful venture, we are offering five courses at the 1974 meeting at Arizona State University, 16-21 June. The course titles are:

- How to Develop a Minicourse
- How to Write for Scientific Journals
- Community Dynamics of Desert Vertebrates
- Community Dynamics of Desert Invertebrates
- Community Dynamics of Higher Desert Plants

Registration forms for these courses and a schedule of course meetings will appear in a future issue. Plan now to attend.




RECOMMENDATIONS:

**1st year operation: Implement Plan C - shift full-time faculty to Program Development Cycle in view of the "first run" status of the program.**

**2nd year - (?) operation: Implement Plan B - achieve a balance between full-time faculty and paraprofessional staffing, split, "excess" time of faculty between PDC and expansion of speciality areas or experimental course work. Every 2-3 years, shift back to Plan C for total faculty involvement in program revitalization and updating.**

**Fig. 2. Schematic flow chart (and recommendations) illustrating the possible effects of implementing instructional technologies on faculty work load and departmental operating level.**

## References


Hahn, T. C. 1971. Audio-tutorial instruction: a case study. *BioScience* 21 (15): 814-819.

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Monroe, C. R. 1972. Profile of the Community College. Jossey-Bass Inc. Publishers. San Francisco, Calif.

Postlethwait, S. N. 1967. Teaching tools and techniques: an audio-tutorial approach to teaching. *Pac. Speech* 1 (4): 57-62.


## NEEDED: PICTURES FOR NEW CAREER BROCHURE

If you have pictures of typical employment or learning situations, please send glossy photographs at least 4 x 5 inches, but no larger than 8-1/2 x 11 inches. Prints for our new career brochure will be selected on 7 November. $10 will be awarded and credit printed for each picture used. Prints cannot be returned.

## NEW STUDENT CHAPTER HANDBOOK

Consider forming an AIBS Student Chapter. Six AIBS student members and a Faculty Advisor, who is an individual AIBS member, can form the nucleus of a new chapter. High school, undergraduate, and graduate students are all eligible. A revised *Handbook for AIBS Student Chapters* will be available soon. Write for a free copy.

# AN EXPERIMENT ON IMPROVING THE TEACHING OF BIOLOGY

H. T. Hendrickson

Department of Biology
University of North Carolina at Greensboro
Greensboro, North Carolina 27412

## Introduction

Everyone these days is talking about the problems of large enrollment introductory courses in biology and proposing solutions. Usually some theory is applied to a course, tried a few times, and, if no loud screams of protest develop and the professor is reasonably happy, it is called an innovative step forward. Very seldom is the concept of a controlled experiment applied by science teachers to their "experimental" teaching.

At the University of North Carolina at Greensboro we have a large (900-1000 students), three credit hours course in introductory biology with all the standard complaints from all concerned parties. Lectures are given in five lecture sections by five different lecturers with about 200 students in each. Since 1970 we have used an audio-tutorial type laboratory; students from all five lecture sections report once a week at their convenience to a uniform programmed laboratory assignment. Some staff members are in the laboratory at all open hours to provide whatever assistance may be required. Because of the open, unscheduled nature of audio-tutorial labs it was considered difficult, if not impossible, for a lecturer to coordinate his laboratory instruction time with the appearance of a maximum number of students from "his" lecture section, thus maximizing reinforcement of ideas presented in laboratory and lecture.

We assumed that it would be "better" if students could work with the same staff people in both lecture and laboratory and then set out to test this assumption. More precisely, we hypothesized that increased contact of the lecturer in the laboratory context would improve student performance. In addition, if the laboratory support staff attended lectures with the students and heard exactly the same information as presented, then this should result in more reinforcement in the laboratory. The expected improvement should be apparent in grades on laboratory quizzes, grades on hourly exams, and "student attitudes."

## Materials and Methods

The control group met in lecture Tuesday and Thursday mornings at 9:30 and went to lab at any time their schedule allowed *except* from 8:00 a.m. to 6:00 p.m. Tuesday. Two graduate student teaching assistants attended this lecture section all term and assisted in the laboratory at scattered hours. The lecturer assisted in the laboratory on Monday afternoons.

The experimental group met in lecture on Monday and Wednesday mornings at 10:00 and attended the audio-tutorial lab between 8:00 a.m. and 6:00 p.m. Tuesday. Three graduate student teaching assistants and one instructor attended this lecture section and assisted in the laboratory all day Tuesday.

To minimize the possibility of personality affecting the outcome, the same lecturer gave the same lectures to both the control and experimental groups. Every practical effort was made to discourage experimental students from attending lab at a time other than 8-6 on Tuesdays. One factor we could not control, which may have had an effect, was that the students in the experimental group were aware of being treated in an unusual manner. Having to come to laboratory during a restricted time quickly identified them as being something "special."

Three hourly exams were given during the term. Each one consisted of 50 multiple-choice questions. Approximately 25 percent of the questions on each test were based on material specifically treated in the laboratory. Both the experimental and control sections were given the same test at the same time.

A final examination of 100 multiple-choice questions (25 percent of which were on laboratory material) was given to both sections at the end of the term. The experimental and control sections took sequentially opposite copies of the same exam at the same hour on different days.

An attitudinal survey consisting of five-part graded responses based on some of the more common statements made by previous students in the course was given to both sections during the tenth week of the term. Additional room was provided for comments. This was an attempt to determine how both sets of students felt about the lectures, text, laboratory, and examinations.

Finally, an informal note was posted in lab during the final week of classes soliciting comments on student reactions to lab in general.

## Results

In comparing the make-up of the two sections we found that there were no significant differences in class composition, sex-ratio, drop rates, proportion on Pass/Not Pass Option, or any other definable criteria. For all intents and purposes, it would appear that we are dealing with two randomly selected sub-populations of students enrolled in our introductory biology course (see Table 1).

On all four of the examinations given the experimental section averaged higher grades, but in no case was the difference statistically significant (prob $< 0.05$). The same thing held true of

**Table 1.**
**Composition of Control and Experimental Classes**

| | Control | | Experimental | |
|---|---|---|---|---|
| | No. | % | No. | % |
| Freshman | 122 | 67.7 | 115 | 56.9 |
| Sophomore | 45 | 25.0 | 72 | 35.6 |
| Junior | 11 | 6.1 | 9 | 4.4 |
| Senior* | 2 | 1.1 | 6 | 2.9 |
| Total** | 180 | | 202 | |
| Male | 19 | 10.4 | 19 | 9.2 |
| Withdrew or Incomplete | 8 | 4.4 | 11 | 5.4 |
| Pass/Not Pass | 30 | 16.4 | 32 | 15.6 |

*Includes seniors, graduate students, and special students

**This indicates final size of the class after the removal of all withdrawals and incompletes.

the final averages of all four exams weighed equally. There was no significant difference between the averages of the experimental and control sections (see Table 2). If one assumes a theoretical grade distribution of 5 percent F, 20 percent D, 40 percent C, 25 percent B, and 10 percent A, then $X^2$ tests reveal that neither of the sections deviates significantly from this expectation. ($X^2$ = 9.179 for controls and 3.853 for experimentals, 4 degrees of freedom).

When one considers only those questions derived from laboratory work, the trend is similar. Only on the second hourly exam was the proportion of experimentals missing laboratory questions significantly smaller than the proportion of controls. On the other two hourly exams and on the final exam, there was no significance to the difference in proportion of people missing laboratory questions for the two sections.

There was no apparent difference in the reaction of the two sections to the lectures based on the attitude survey. However, there were significant differences found on most of the other items tested. The experimental section was much less likely to consider the reading assignments excessive; conversely, more people in the control section found the readings burdensome. The experimental section gave consistently more positive opinions to questions about the lab than did the control section. The difference in response was highly significant on four of the five points graded. The experimental group also rated the fairness of the hourly exams higher than did the controls (both sections had taken two exams at this time), and the experimentals were more inclined to consider the tests reasonable though hard and to notice the stress on principles *and* details than were the controls.

The informal invitation to comment on lab offered in the last week of classes yielded no noticeable difference in proportion of favorable responses from the experimental vs. non-experimental sections but the response rate itself was drastically lopsided. A much greater proportion of students in the experimental section wrote in comments and suggestions than was true for the course as a whole.

## Discussion and Conclusions

In light of these data, it seems safe to conclude that the heavy investment of faculty time used to maximize lecture-laboratory coordination and continuity has produced no measurable intellectual benefits based on grades. Having the same personnel in laboratory as you have in lecture in no way affects the student's chances of getting a good grade. However, this continuity of faculty between lecture and laboratory does seem to improve the way the student feels about the course—particularly the laboratory part of the course. Students under our experimental conditions were much more inclined to believe in the ability, preparedness, and concern of the laboratory staff and the value of the lab as a part of the biology course than were the students under our control conditions. Despite all these differences, and the obvious differences in treatment, both sections gave virtually identical responses in evaluating the degree of coordination between lecture and laboratory.

It is possible that the differences in response to the survey on attitudes are not due to the actual differences in treatment but only to the belief on the part of the students in the experimental group that they were somehow different and "special." Theoretically, this belief of being better than ordinary students in the course could cause a different feeling for the course and staff, and particularly for the laboratory where they have maximum close contact with the people who have identified them as unusual. Because of the way this experiment was set up, there is no way to separate these two factors. The experimental group *did* get treatment which was different and special so that their self-identification as exceptional, with its attendant expectations and modified perceptions, could be possible. It would be interesting to design an experiment to test this idea.

While this more positive outlook towards the course, the laboratory, and the staff may be very gratifying and improve the general working conditions for all concerned, it probably has no meaning in an educational sense. The students in the experimental section may be more content (or less "turned off") but they haven't learned any more of the subject.

I think it is safe to conclude that to improve the transfer of information from instructor to student, it will be necessary to do something other than increase the amount of time spent by faculty in classes with students.

**Table 2.**

**Analysis of Test Scores in Control and Experimental Classes**

| Test | Class | n | $\bar{x}$ | $S^2$ | $\hat{\sigma}_{\bar{x}}^2 = \frac{S^2}{n}$ | difference | $\hat{\sigma}$ $\bar{x}$ exp. — $\bar{x}$ cont. |
|---|---|---|---|---|---|---|---|
| 1 | Experimental | 202 | 80.61 | 109.72 | 0.543 | 1.74 | 1.09 |
| | Control | 180 | 78.87 | 117.14 | 0.650 | | |
| 2 | Experimental | 202 | 66.81 | 131.55 | 0.651 | 0.16 | 1.23 |
| | Control | 180 | 66.65 | 158.02 | 0.877 | | |
| 3 | Experimental | 202 | 73.73 | 121.02 | 0.599 | 0.49 | 1.17 |
| | Control | 180 | 73.24 | 143.51 | 0.797 | | |
| 4 | Experimental | 202 | 69.15 | 114.69 | 0.567 | 0.54 | 1.09 |
| | Control | 180 | 68.61 | 112.05 | 0.622 | | |
| Total | Experimental | 808 | 72.57 | 146.40 | 0.181 | 0.73 | 0.62 |
| | Control | 720 | 71.84 | 154.41 | 0.214 | | |

# INFORMATION FOR CONTRIBUTORS

**Correspondence:** All correspondence should be directed to the Editors, *AIBS Education Review*, American Institute of Biological Sciences, 3900 Wisconsin Avenue, N.W., Washington, D.C. 20016.

**Editorial Policy:** The Editors will welcome manuscripts on biological education from administrators, faculty, students, and those outside academe who are engaged in educational pursuits. Articles describing research studies in biological education, new learning programs, and viewpoints stimulating dialogue in biological education are requested.

The usual length of feature articles is 3,000 words. Manuscripts must conform to the C.B.E. Style Manual. Illustrations are acceptable, but text length should be adjusted to accommodate them. The recommendations of reviewers will be considered for each manuscript submitted. The Editors reserve the right to edit manuscripts, but authors will have an opportunity to approve galleys.

Papers are accepted for publication on the condition that they are submitted solely to the *AIBS Education Review* and that they will not be reprinted or translated without the consent of the Editors.

**Preparation of Manuscript:** In the preparation of copy, manuscripts should be neatly typewritten in 57 character lines, double-spaced throughout, including references, tabular material, footnotes, etc., on one side only of 8½ x 11 inch white bond paper. No abstract is required. Please submit the original plus two additional copies. The author should retain a copy. A separate title page should be provided, and footnotes, figure descriptions, and tables should be typed on sheets separate from the text. At least one of the copies must be complete with figures, tables, and references. Please convert all weights and measures to the metric system.

**Illustrations:** Illustrations such as photographs, maps, line drawings, graphs, etc., should be submitted, unmounted, with the manuscript. Only black and white illustrations will be accepted. Number figures consecutively and identify on the reverse side. Glossy photographs are required and must be at least 4 x 5 inches but not larger than 8½ x 11 inches. Originals of drawings are requested. Generally, drawings larger than 8½ x 11 inches are not acceptable. Lettering on all illustrations must be sufficiently large to allow reduction to a single column. Figure captions for each illustration should be typed on a separate page and accompany the illustration.

**References:** In the text, references to literature citations should be designated by the author's name and year of publication in parentheses. If there are more than two authors, only the senior author's name should be listed in the text with the abbreviation "et al.," for example: (Smith et al. 1965). Only published references should be given in the References section, and each should conform in style to the name-and-year system of the C.B.E. Style Manual.

# MINICOURSE ON MODULE MAKING

**Richard B. Glazer and**
**Joan G. Creager**
AIBS Staff

As a way of providing a new alternative for meeting-goers, the Education Division presented a "Minicourse on Module Making" at the 1973 Annual Meeting. This course was offered in two hour sessions five successive mornings under the direction of Robert N. Hurst of the Purdue University Minicourse Project. Dr. Hurst was assisted by Darrel L. Murray of the University of Illinois, Chicago Circle Campus, and by the authors of this report. A $5 registration fee was paid by the participants. The additional costs of the minicourse were defrayed by the AIBS Consultants Bureau which operates under a grant from the National Science Foundation.

Registration for the minicourse was held to a maximum of 30. Of the 28 actual participants, seven registered for and received one hour of graduate credit for their participation in the course. Arrangements were made through the University of Massachusetts Division of Continuing Education for the awarding of graduate credit by the Zoology Department. Individuals desiring credit paid an additional $15 to the University, attended sessions three hours per day, and engaged in study and previewing of BIOTECH modules on demonstration. We mention the details of the academic credit arrangements because this event marked the first occasion that a biologist could receive academic credit for participating in a course while attending an AIBS meeting. In view of the trends in higher education for providing alternative ways in which academic credit may be earned and the acceptability of learning taking place in many diverse settings, we feel that this course has set the stage for the AIBS Annual Meeting to become a legitimate setting for these programs.

Because this minicourse was a new venture and because evaluation is an important component of any learning situation, new or established, we asked participants to complete an open-ended evaluation form. Eighteen participants voluntarily completed the form. Of those responding, 17 indicated that the course directors had provided sufficient guidance to allow them to learn how to prepare a module. Some respondents did feel that more time or more facilities, particularly audio-visual equipment, would have improved the effectiveness of the course.

Some of the merits of the course mentioned most frequently by the participants included the opportunity to work with people who were experienced in the preparation of modules, the exposure to a new type of teaching, and the different perspectives they gained through group activities with both the course directors and the other participants. The small group discussions and writing sessions, the "hands-on" experience of preparing a module under the guidance of course directors, and the self and group evaluations were considered to be significant aspects of the course by many of the participants.

The major problem perceived by the participants was the lack of time to do a thorough job of preparing a module. The several suggestions for solving this problem included beginning with a full day pre-meeting session with shorter daily sessions, four-hour daily sessions, or extending the course several days beyond the end of the meeting. Another significant recommendation was that participants should receive prior to the meeting a kit of materials with specific information on what was expected of them and what kinds of materials to bring with them. These suggestions are being given careful consideration in the development of course offerings for next year's meeting.

Since this course was offered on a "let's see what happens" basis, we were encouraged to find that 14 of the 18 respondents indicated the minicourse was the major or sole factor in their decision to attend the AIBS meeting. This finding provides significant impetus for the development of similar offerings at future meetings. We take this opportunity to invite our readers to send us suggestions for the kinds of courses they would like to see offered at future meetings.

## BIO-STUDENT'S VOICE

To All AIBS Members:

For any AIBS student chapter that is trying to get off the ground in getting organized and in attempting to find some ideas for fund raising or for general chapter activities, here are a few projects that those of us in the Ladycliff College Student Chapter tried this year and found successful:

1) Stationery sales. We realized over $100 on each of two sales.

2) Volleyball game. Our chapter members challenged our college's faculty. Even though we didn't come out on top scorewise, our event made everyone at our college aware that our AIBS chapter is active, and players and spectators enjoyed the victory party at the Student Union.

3) Newspaper. "Vulture" is the title of our publication, named for its unique perspective presented by its contents which consist of factual articles concerning topics of current biological interest, science anecdotes, and ecology cartoons. The newspaper served as an opportunity for our chapter members to be creative and to share our ideas with our fellow students.

4) Christmas party. This was a get-together for our chapter members and friends with Christmas carols provided by our members.

5) Donation of funds to other clubs on campus.

6) Sponsorship of chapter members to attend conferences. Some of our members attended the AIBS Regional Conference held at Western Connecticut State College on 14 April 1973. We really appreciated the experience of meeting members from other chapters, exchanging ideas, and sharing research information which was afforded by the Conference.

7) Veterans' Hospital entertainment. Sponsored by our chapter, a singing group with guitar accompaniment performed folk and rock selections. The vets were an enthusiastic audience, and we all left with a feeling of accomplishment.

The members of the Ladycliff College Chapter of AIBS share our projects with you in the hope that they might give you some ideas for more activities for your own chapters. We hope that you will be as fortunate as we have been in being able to carry out these projects.

Respectfully submitted,
Jane Lewis, Past President
Ladycliff College AIBS Student Chapter
Highland Falls, New York 10928

## NEWS SERVICES AVAILABLE THROUGH THE CONSULTANTS BUREAU

**Joan G. Creager**
AIBS Staff

As has been the case for a number of years, consultant services are still available for the improvement of facilities and the evaluation of curricula. Last year's workshops proved to be an effective and successful addition to the consultant services. As a result, there are consultants now prepared to offer workshops on the following topics:

**Population and Pollution** - how to prepare college students to offer instructional programs in elementary and secondary schools.

**Investigative Laboratory** - how to plan, organize, and execute an investigative laboratory in which students carry out experiments of their own design.

**Modules** - how to prepare modularized instructional packages for the teaching of skills, concepts, and effective learning.

**Ethics for Environment** - how to incorporate ethical implications of environmental issues into the teaching of biology.

Most workshops consist of two full days of participation, often on a Friday and Saturday. If you find one of the above topics particularly appealing, or if you have an idea about another kind of workshop, please let us know your interests.

### Agricultural Consultants

Because the AIBS is concerned about the need to offer services to a broad spectrum of educators in the life sciences, we have solicited the services of agricultural scientists who are willing to provide consultant services to life science departments interested in developing or improving programs in various areas of agriculture. If your department might profit by the services of a consultant, please write us describing the nature of your programs and your needs.

### Allied Health Consultants

While the AIBS does not provide services in this area, we recognize that many colleges maintain, or are developing, allied health programs related to, or in conjunction with, biology departments. We have learned that allied health consultant services are available through the Association of Schools of Allied Health Professions, One Dupont Circle, N.W., Washington, D.C. 20036. For further information, contact their Executive Director, Mr. William Samuels.

# Report of the AIBS Manpower Survey

Joan G. Creager
AIBS Staff

*This study was partially supported by the National Science Foundation and the National Academy of Sciences.*

The American Institute of Biological Sciences has been concerned with manpower in the life sciences, with the questions of supply and demand, graduate school, employment experiences, and, in particular, with the problem of unemployment. Since virtually no current manpower information was available about biologists, the AIBS felt compelled to survey the manpower situation within its membership and that of selected adherent societies.

In December 1972, a questionnaire was distributed by AIBS to 26,000 individuals, 13,000 of whom are members. Four adherent societies assisted with this survey by distributing the questionnaire to their members during the first three months of 1973. The societies, selected to maximize the diversity of the biological community represented, were: the Botanical Society of America, the American Society of Microbiologists, the Ecological Society of America, and the American Society of Zoologists. Since there was no way within the budgetary constraints of this study to eliminate overlap among the mailings created by individuals who are members of two or more societies, it is impossible to determine the overall rate of response. While this problem was recognized at the planning stage, it was felt that the advantages of distributing the questionnaires to the members of the several societies outweighed the difficulties of overlap. Table 1 provides the percent response for each society and selected characteristics of its members.

**Table 1.**
Response rate for societies and selected characteristics of their members

| Society | Approx. Number of Members | Number of Responses to Survey | Percent Response | Percent of Responses By Degree Ph.D. | M.S. | By Sex Male | Fem. |
|---|---|---|---|---|---|---|---|
| Total | -* | 7,153 | -* | 73 | 19 | 82 | 18 |
| AIBS | 13,000 | 4,164 | 32 | 75 | 17 | 82 | 18 |
| BSA | 3,200 | 886 | 28 | 79 | 15 | 80 | 20 |
| ASM | 16,000 | 994 | 6 | 68 | 17 | 74 | 26 |
| ESA | 4,700 | 1,152 | 24 | 81 | 12 | 91 | 9 |
| ASZ | 3,975 | 1,586 | 40 | 90 | 6 | 83 | 17 |

*These data omitted for reasons described in text.

The variations among societies in percent response to the questionnaire are probably a function of the proportion of members concerned with education. Even though the questionnaire explained that we were concerned about all manpower in the biological sciences, a greater proportion of responses were received from personnel in educational institutions than from those in government and industry.

For the entire sample, 73% of the respondents hold a Ph.D., although there is variation by society from 68% for the ASM to 90% for the ASZ. Most of the remainder of respondents hold Master's degrees except for 439 Baccalaureate holders, 137 M.D.'s, and 17 Associate degree holders. With respect to sex, 18% of the entire sample are women, while 26% of the ASM members are women, and 9% of the ESA members are women. The number of respondents who are members of ethnic minorities is too small to yield reliable statistics. There are 74 blacks, 19 Puerto Ricans, 13 Mexican-Americans, 21 other Spanish speaking people, and 15 American Indians.

By far the greatest majority of respondents (73%) are employed by an institution of post-secondary education. Since American Science Manpower 1970 (National Science Foundation, 1971) reported that 60% of biologists were then employed in educational institutions, it appears that in our sample the employer category "institutions of higher education" is over-represented. The percent employed in each of several employer categories is shown in Fig. 1 Among the categories included in "other" are elementary and secondary education, government, business, and industry. The relatively large proportion of ASM members falling in the "other" category is attributed to the large number of members employed in industry.

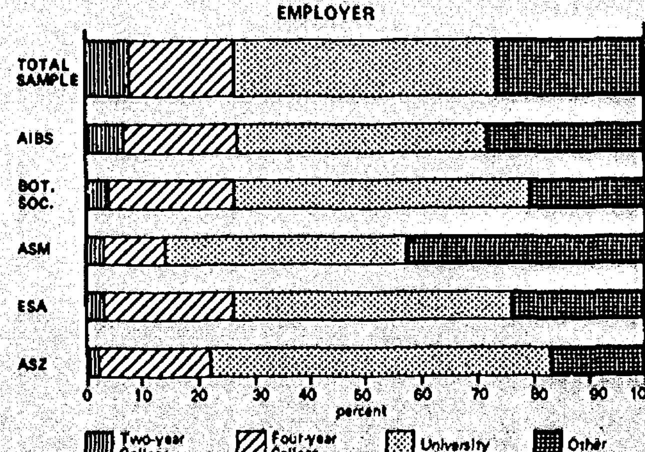


Fig. 1

Important to an understanding of the expertise available in the life sciences is information on the graduate school experiences. The field of highest degree of respondents is given in Fig. 2. As can be seen from the figure, over one-third of the respondents hold their highest degree in relatively unspecialized fields of general biology, botany, and zoology. The apparent generality of degrees may be due to a preponderance of Masters level individuals in these categories and to the practice of awarding a degree in a general field even though the individual's research may have been highly specialized. A more detailed study of this issue would be needed to ascertain the degree of specialization within this component of the biological community.

FIELD OF HIGHEST DEGREE

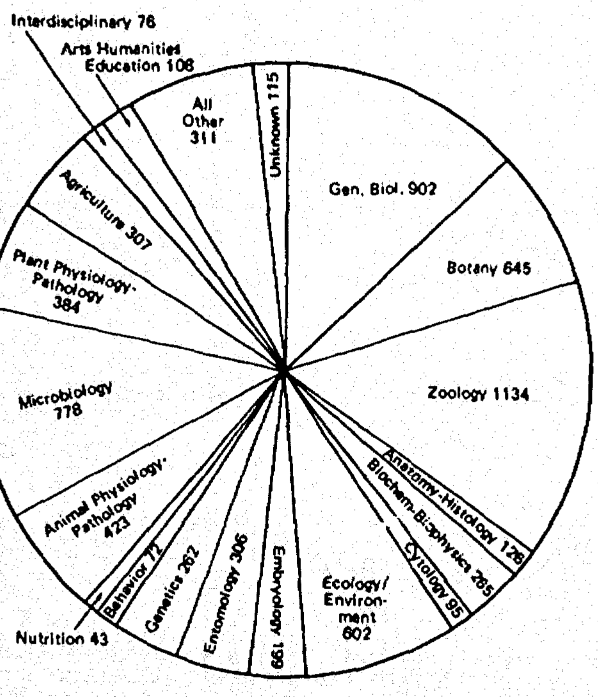


Fig. 2

Sources of graduate school support affect the manpower supply. Data pertaining to sources of graduate school support are provided in Fig. 3. Among Ph.D. candidates, government funds account for about 40% of the support for both men and women. Universities provide about 34%, with a greater proportion going to men than to women. Women appear to have made up this deficit out of personal funds. For Ph.D.'s there has been a tremendous variation over time in the proportion of support from these different sources. Before 1950 only 8% of support came from government sources; since 1960 over 50% came from government sources. All other sources of support have shown relatively proportional decreases over time. With respect to Masters candidates, there has been less government support and less consistent patterns of support, both with respect to sex of candidate and with respect to time trends. Masters candidates do, however, tend to finance more of their education from personal funds.

There are significantly more Ph.D. candidates than Masters candidates supported by competitive fellowships. For Masters candidates the proportion of individuals supported has risen over time from 24% before 1950, to 31% during the fifties, to 40% since 1960. The pattern of support for Ph.D.'s is less consistent and ranged around 45% before 1960 and 60% after 1960.

SOURCES OF SUPPORT FOR GRADUATE STUDY

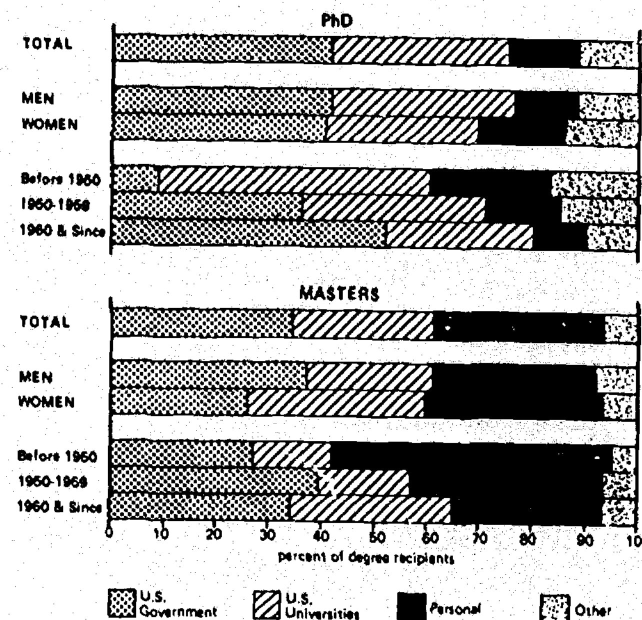


Fig. 3

Postdoctoral fellowships serve as a measure of the degree of highly specialized training obtained by respondents. Of the 5,019 Ph.D.'s responding to the questionnaire, 44% have held postdoctoral fellowships. The percentage of women who have held postdoctoral fellowships (48%) is higher than that for men (43%).

The current manpower situation in the biological sciences is reflected by employer category and by the degree of unemployment. Fig. 4 shows the percentages of all respondents by employer category and the variations in employer category by sex and by highest degree held. Women and Masters level respondents held relatively fewer positions in universities and relatively more positions in two year colleges.

EMPLOYER CATEGORY

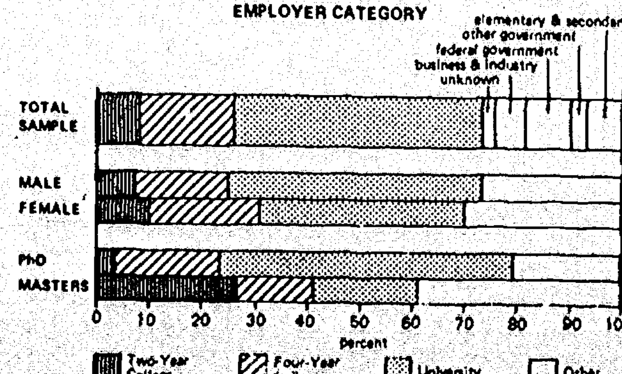


Fig. 4

Of all respondents 9% indicated that they had been unemployed at some time in 1972. Of this 9%, about half were unemployed three months or less; the remainder were unemployed for more than three months. As indicated in Fig. 5, twice as many women as men were unemployed and those holding higher level degrees were less likely to be unemployed than those holding lower level degrees. In the under 30 age group unemployment was extremely high, probably because of the large number of full time students in this age group. Of the 731 respondents in this group, 144 (20%) indicated that they were students. Variations in the percentage of unemployment for other age categories are probably due to there being at least some students in the 30-39 age group and a number of retired individuals in the 60 and over age group. Thus, unemployment in 1972 was approximately 6% overall, slightly lower for individuals between 40 and 60 and slightly higher among the younger and older respondents.

UNEMPLOYED AT SOME TIME DURING 1972

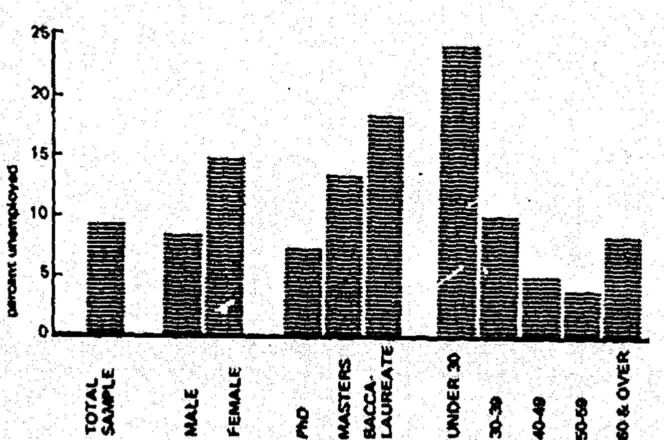


Fig. 5

Of those currently employed, 21% indicated that they were seeking new positions. While these individuals do not contribute to the unemployment problem, they do indicate a degree of dissatisfaction with current employment. With respect to current employment status, 78% of the respondents hold one full-time position. Among Ph.D.'s, 83% hold one full-time position, but the proportion holding one full-time job drops by degree level to 59% for Baccalaureate degree holders. The proportion of respondents holding one or more part-time jobs is inversely related to degree, varying from 1.5% among Ph.D.'s to 11.4% among Baccalaureate holders. Six percent hold a part-time position in addition to their full-time position and 3% hold one or more part-time jobs. About 3% of the respondents are students, almost 2% hold postdoctoral positions, and slightly more than 1% are retired. About one-third of the retired persons hold a part-time position. Of greatest import among the statistics pertaining to the currently employed is that 1% are on notice of termination.

Of the 6,224 individuals who responded to the item about retirement programs, 50% have a vested interest in their program, 32% do not have, and 18% don't know whether or not they have a vested interest in their retirement program.

The type of work activity engaged in by the majority of respondents is teaching, either as the primary activity or in combination with research or administration, as is shown in Fig. 6. The major difference between the work activities of men and women is that women hold relatively more positions involving full-time teaching while men hold relatively more positions involving a combination of research and teaching. Differences with respect to highest degree held are that half of the Ph.D.'s are engaged in research-and-teaching and only 11% of the Masters holders are so engaged. Over one-fourth of Masters holders reported work activities falling in the "other" category. Included in the "other" category are professional services, fellowships, development and design, and technical and support services. Variation in work activities by employer category show that half of those employed in two year colleges are engaged in full time teaching; one-third of those in four year colleges and only 8% of those in universities are so engaged. These differences are more than compensated by the increase in teaching and research positions from 6% in two year colleges to 36% in four year colleges to 64% in universities. The work activity of those employed by business and industry and of those employed by the federal government differ markedly from those in educational institutions. As would be expected, there is almost no teaching and a much larger proportion of research and administration. Among those employed in business or industry, 44% hold positions falling in the "other" category.

WORK ACTIVITY

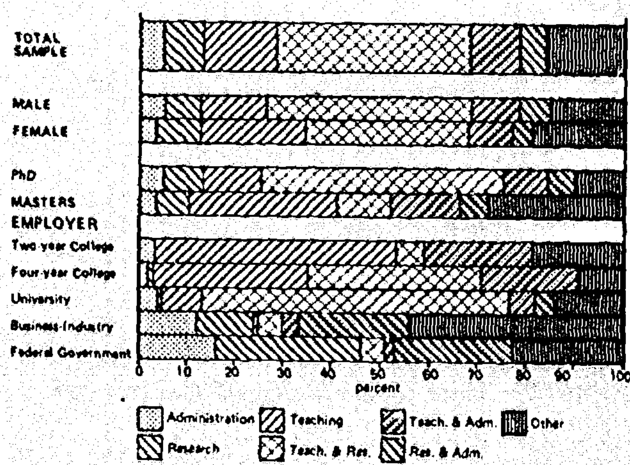


Fig. 6

With respect to federal support for current employment, 16% of respondents reported full support and 22% reported partial support. By far the greatest proportion of federal support goes to Ph.D.'s in universities as is indicated in Fig. 7. The primary sources of federal support are the health related divisions of the Department of Health, Education, and Welfare, which provided funds for nearly half of those receiving support, and the National Science Foundation, which provided funds for slightly more than one-third of those receiving support.

Salary data were obtained for the calendar years 1972 and 1971. Data on income other than salary for calendar year 1972 were also obtained. Variations in 1972 salaries are reported in Fig. 8 by degree level, sex, and age. Salaries increase significantly with age up to the age of 60 and then level off. Mean women's salaries are from $1,800 to $2,700 lower than those of men, depending on degree level. Variations in 1972 salary among geographic regions and among fields are relatively small. There are too few respondents among minority groups to obtain reliable salary statistics. Mean 1971 salaries range from $500 to $1,000 less than 1972 salaries.

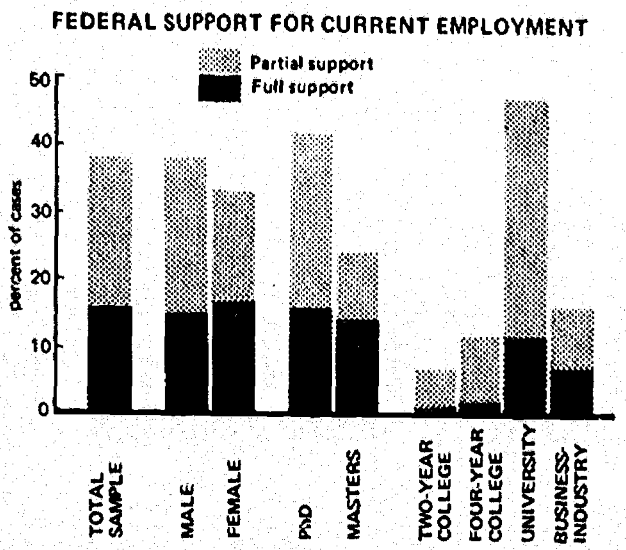


Fig. 7

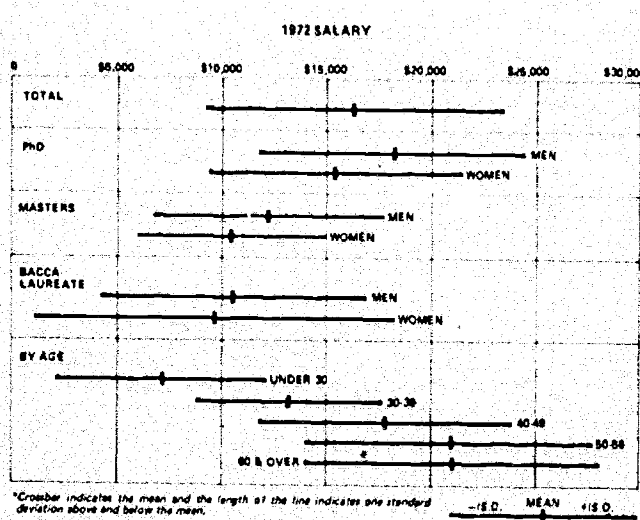


Fig. 8

Variations in the number of respondents specifying selected fields by highest degree, professional identification, employment during the last five years, and current employment are reported in Table 2. Among respondents in general fields a much smaller proportion identify themselves as generalists than are employed or received degrees in general fields. In contrast, a significantly larger proportion of respondents identify themselves as ecologists and environmentalists than received degrees or are employed in this field. For several fields (plant physiology and pathology, biochemistry, biophysics, and entomology) there is a consistent decrease in the number indicating a given field from degree to current employment. Conversely, there has been a constant increase in the number of respondents indicating interdisciplinary activities.

**Table 2.**
**Field Affiliations**

| Field | Highest Degree | Profes. Ident. | Employment Five yrs. | Employment Current |
|---|---|---|---|---|
| General biology, botany & zoology | 2,681 | 1,555 | 2,442 | 2,222 |
| Anatomy, histology, cytology & embryology | 420 | 533 | 462 | 445 |
| Ecology & environment | 602 | 895 | 640 | 676 |
| Animal physiology & pathology | 423 | 575 | 419 | 411 |
| Plant physiology & pathology | 384 | 321 | 232 | 214 |
| Microbiology | 778 | 865 | 710 | 693 |
| Biochemistry & biophysics | 265 | 261 | 231 | 209 |
| Entomology | 306 | 258 | 185 | 183 |
| Genetics | 262 | 283 | 204 | 195 |
| Agriculture | 307 | 309 | 333 | 327 |
| Interdisciplinary | 76 | 124 | 196 | 226 |

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3900 Wisconsin Avenue, N.W.
Washington, D.C. 20016